NETWORK LEVEL SAFETY ASSESMENT FOR THE ROADS IN PATHANAMTHITTA DISTRICT

Resmi R Pillai [1], Meenudev G [2]

ABSTRACT

As we all know that from past few years the accident rates were increasing day to day and these crashes cause tremendous loss interms of death, injury, properties etc hence effective transportation planning is necessary for fore-coming days. Transportation problems are framed within three broad categories:-problems that affect transportation, transportation service problems and problems caused by transportation. These all problems are caused due to increase in demand for transportation due to increase in population and income, congestion, safety etc. Transportation planning involves not only the planning forroad geometric; which involve mobility planning also. Here we aredealing with a safe road network level planning aspects for a safe transportation system. The aim of our project is to provide diverse source of information and knowledge about the road networks in Pathanamthitta district. The implementation of safe road networkis an imperative need since social and economic development simultaneously with environmental protection is necessary.

KEYWORDS: Green Hospital, Green Initiatives, Water Management, Waste Management.

INTRODUCTION

Pathanamthitta District , is one of the 14 districts in the Indian state of Kerala. The district headquarters is in the town of Pathanamthitta. There are 1 district panchayat, 8 block panchayat, 53 grama panchayat. According to the 2011 Census of India, the population was 1,197,412, making it the third least populous district in Kerala (out of 14), after Wayanad and Idukki. Pathanamthitta has been declared the first polio-free district in India. The district is 10.03% urbanised. Pathanamthitta is one of the richest districts in India with just 1.17% poverty as of 2013, which places the district among top 5 districts in India with least poverty. Pathanamthitta has an average elevation of 18 meters (62 ft) above sea level.

The main trunk road from south to Sabarimala starts from MC Road at Adoor via NH 183A Pathanamthitta. From The North it Starts from Thiruvalla MC Road and Continues through State Highway 7 (Kerala), The Main Eastern Highway (Punalur-Muvattupuzha Road/SH-08), Main Central Pathanamthitta is the meeting point of two major State Highways T.K. Road (SH – 07) and Main Eastern Highway (Punalur-Muvattupuzha Road / SH – 08). The town is well connected to major towns and cities inside and outside Kerala by the State run K.S.R.T.C and private buses as well as Luxury Services. Both the KSRTC and private buses play equal roles in satisfying the transportation needs of the town. The cities of Kollam, Thiruvananthapuram, Kochi, Thrissur etc. are connected by KSRTC services whereas hi-range townships like Punalur, Kumali, Pala and the Malabar Area of Northern Kerala are connected by private bus services. KSRTC is running chain services that connect Pathanamthitta with the City of Kollam via Adoor, Also to Chengannur railway via Elavumthitta or Kozhencherry. Plenty of A/C Luxury Bus services are operated from Pathanamthitta to Bangalore, Chennai, Mangalore and Mumbai on a daily basis.

KSRTC bus depots in Pathanamthitta district are Pathanamthitta, Konni,Thiruvalla, Adoor, Mallapally, KSRTC Operating centers are situated in Ranni, Pandalam and a Temporary KSRTC Depot working by during Sabarimala season at Pamba. (Kesavadasapuram-Angamaly Road/SH-01), NH 183A Kollam-Teni via Adoor- Pathanamthitta.

QUANTUM GEOGRAPIC INFORMATION SYSTEM (QGIS)

QGIS (Quantum Geographic Information System) is a free, open-source software that allows users to create, edit, visualize, analyze, and publish geospatial information. ArcGIS (commercial/proprietary) and QGIS (open source) are the most popular GIS software programs. Their interfaces look very similar and many of the analysis tool can be found in each program.

Gary Sherman began development of Quantum GIS in early 2002, and it became an incubator project of the Open Source Geo spatial Foundation in 2007. Version1.0 was released in January 2009.

In 2013, along with release of version 2.0 the name was officially changed from Quantum GIS to QGIS to avoid confusion as both names had been used in parallel. Written mainly in C++, QGIS makes extensive use of the Qt library. In addition to Qt, required dependencies of QGIS include GEOS and SQLite. GDAL, GRASS GIS, PostGIS, and PostgreSQL are also recommended, as they provide access to additional data formats. As of 2017, QGIS is available for multiple operating systems including Mac OS X, Linux, Unix, and Microsoft Windows. A mobile version of QGIS was under development for Android as of 2014.QGIS can also be used as a graphical user interface to GRASS. QGIS has a small install footprint on the host file system compared to commercial GISs and generally requires less RAM and processing power; hence it can be used on older hardware or running simultaneously with other applications where CPU power may be limited.[citation needed].QGIS is maintained by volunteer developers who regularly release updates and bug fixes. As of 2012, developers have translated QGIS into 48 languages and the application is used internationally in academic and professional environments. Several companies offer support and feature development services.

QGIS enables users to visualize their data using maps, charts,

and diagrams while customizing the presentation with a variety of symbology choices. The capabilities for geographical analysis provided by QGIS, including as buffer construction, spatial querying, and Geo processing. For more complex geographical analysis users can additionally make use of plugins and algorithms. QGIS also makes it simple to share and publish Geo spatial data as maps, online services, or print maps in a variety of file formats, such as shape files, Geo TIFFs, and KML files.In order to prepare printed map with QGIS, Print Layout is used. It can be used for adding multiple map views, labels, legends, etc.

METHODOLOGY
Selection of area
The thirteenth district in the sate of Kerala nestles its head on the slopes of western ghats and stretches to the low-lying rice fields bordering Alappuzha district. The district consist of three natural divisions viz the Lowland the Midland and the Highland. The highland stretches through the western ghats and descends midland in the centre, to the lowland and coconut gardens on the western borders of Alappuzha district. The topography of the district is highly undulating. It starts from the tall hill slopes covered with thick forests on the east along the mountains down to the valleys and small hills to the flat land of coconut trees in the west. Pathanamthitta engrossed on the hilly terrain of Kerala can rightly be called the headquarters of pilgrimage tourism in the state.

As, Pathananthitta district is well known as headquarters of pilgrimage; a network level safety is necessary. Therefore Pathananthitta district is adopted

Data collection
The preliminary step is the collection of sufficient data regarding the population and accident intensity from various institutions which provide immense help in the QGIS analysis.

I. Accident data
Accident data is one which include primary data collection. Accident data of year 2019,2020,2021 is collected from NATPAC, Thiruvananthapuram and data includes number of death, Grievance, minor cases, number of victim, speed limit of vehicle, weather condition, road surface, collision type, place of occurrence, accident cause type etc.

Accident data is necessary for :

Finding out number of accidents in each locality
i.Determing black spot
ii Population data

Pathanamthitta is one of districts of Kerala in India, Pathanamthitta District population in 2023 is 1,664,403 (estimates as per aadhar uidai.gov.in Dec 2023 data). As per 2011 census of India, Pathanamthitta District has a population of 1,197,412 in 2011 out of which 561,716 are male and 635,696 are female. Population of Pathanamthitta in 2022 is estimated to be 1,580,584 inhabitants. Literate people are 1,062,553 out of 499,181 are male and 563,372 are female. People living in Pathanamthitta District depend on multiple skills, total workers are 392,794 out of which men are 281,854 and women are 110,940. Total 31,590 Cultivators are depended on agriculture farming out of 28,683 are cultivated by men and 2,907 are women. 35,216 people works in agricultural land as labor, men are 29,909 and 5,307 are women. Pathanamthitta District sex ratio is 1,132 females per 1000 of males. Next Pathanamthitta District Census will be in 2022- 2023.

QGIS Analysis
QGIS (Quantum Geographic Information System) is a free, open-source software that allows users to create, edit, visualize, analyze, and publish geospatial information.

There are many benefits to using QGIS. First, the software offers many free online resources and maps available to download. QGIS also accepts many vector file formats. Finally, there are a variety of plug-ins for potential use, and there are always new plug-ins being created. Plug-ins are extra applications that can be downloaded to complete a specific task that is not easily accomplished otherwise. An introduction on how to download and operate QGIS are given below. Even if you have little to no QGIS experience, you can learn to create basic maps and perform simple spatial analysis from several types of data inputs.

Download the Software
Download the software at: https://qgis.org/en/site/for users/download.html. The QGIS download may also install other supplementary applications. Newer versions of QGIS will create a different file format. These older files can be opened by the newer QGIS version, but any saved changes will exist in the new format. Now that QGIS is downloaded and opened, let's look at some basic tools. Use the plus and minus magnifying glass icons to select an area to zoom in or out of to a desired extent. Alternatively, single-click with the mouse while using these tools to zoom to a default extent. It is also possible to zoom in and out with the mouse wheel. Use the hand icon or the arrow keys to change the position of the map area within the viewing frame.Use the magnifying glass with arrows to show the entirety of the largest visible layer.
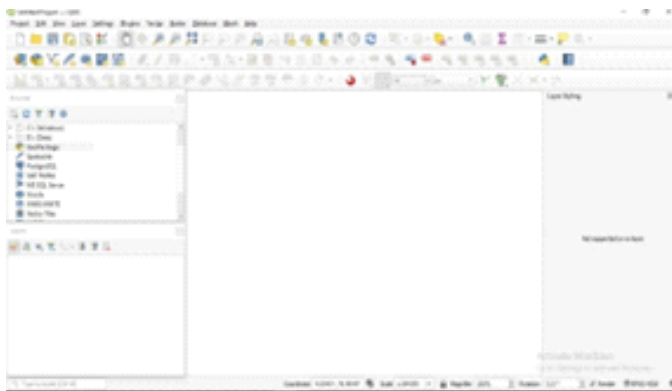
Basemap
Basemap is an underlying reference map or layer used to orient the uploaded data in space.

Required Files: The basemap and most layers exist in multiple file types: .shp, .shx, .cbg, .dbf, .prj, and .qpj. The .shp file is used to upload a layer into the QGIS workspace. However, do not delete the .shx file. The .shp and .shx file must both be in the file directory for QGIS to successfully upload the desired basemap or layer. Therefore, deleting the .shx file will result in an error. It is common practice for a layer to be referred to only as a shape file. When downloading a layer, the files will often include the necessary .shx file even though only the .shp file is mentioned. The directory used when initially uploading and creating the file is recalled when returning to the map later. If the file is moved to another folder, QGIS will require a new directory to be established, or else that layer will be deleted.

LSGD boundary of Pathanamthitta district

Uploading Layers

A layer displays the spatial distribution of quantitative and qualitative data. The term "layer" broadly describes data shown as a raster, polygon, line, or point. A map is typically comprised of multiple layers over a basemap. A basemap is the layer that orients the map in space.

To upload a layer: Drag and drop the .shp file into the layers panel OR Layer > Add layer > Add vector layer > Browse > Open

Data without Coordinates Add Data Points

If the relative location of a data point is known but the precise GPS coordinate is not known, there are two ways to bring the data into a usable form in QGIS.

1. Use Google Maps to acquire the GPS data point and record these values in an Excel sheet, and follow the Data with Coordinates section below.

OR

2. Layers > Create layer > New shapefile layer > Name the file > OK
Highlight this new layer in the layers panel > Toggle editing > Add feature > Select where to place the data point > Assign an ID value

Geo referenced shape file of Pathanamthitta district

The toggle icon (a yellow pencil) allows for a layer's attribute table to be edited. In some cases, a layer may be locked and not editable. To unlock the layer, you must save the layer using save as. The new copy of the layer can then be toggled. Press toggle after completing all edits to save the layer changes.

Data with Coordinates Upload Excel Data

Data's latitudinal and longitudinal coordinates must first be recorded in an Excel spreadsheet. Then, the sheet must be saved as a comma separated variable (.csv) file. Comma separated variable is an easy-to-use format that QGIS can interpret. Add layer > Add delimited text layer… > Browse > Select CSV

If first record has field names, indicate so. Identify longitude (x) and latitude (y) fields.

If you expect to need to enter additional data to the Excel/.csv sheet over time, then select watch file to link QGIS to the Excel sheet and automatically update any changes.

After uploading a basemap or layer, assign the CRS. If the window does not automatically appear, right-click on the layer and select set layer CRS. Remember, layers that do not have an appropriate CRS will have a layer viewed in the wrong location in comparison to the other layers

Data and Values

Attribute tables are like Excel spreadsheets. They store information about the uploaded data. When dealing with a specific layer, first select the layer in the layers panel.Toggle

allows for a layer's attribute table to be edited. In some cases, a layer may be locked and unable to be edited. To unlock the layer, you must save the layer using save as. The new copy of the layer can then be toggled. Press toggle after completing all edits to save the layer changes.

Adding Columns

Select layer in the layers panel > Attribute table > Add fields > Type options describe the data in the field (text, whole number, etc.).

Merging Files

In some cases, it may be useful to add a column of data from another Excel/.csv sheet or layer to the uploaded shapefile since it is easier to input data into Excel than the attribute table. If using the Excel file type, save as a .csv file before uploading to QGIS. Before merging the files, be sure that the .csv file has one ID column identical to that of the previously uploaded shapefile so that QGIS knows which rows to match. If an ID column is not already created for the shapefile, use any value that will be unique for every row.To upload the .csv file containing the new columns of data:

Layer > Add layer > Add delimited text layer… > File format > Select CSV (comma separated values) > Under geometry definition, select no geometry (attribute only table)This will upload to the layers panel as a .dbf file.

To merge the two files:

Double-click on the layer to be merged OR right-click > Properties

Joins > + > Join layer > .dbf file name > Join field and target field must contain identical values that are unique per row > OK

The original shapefile should now have new columns from the merged .dbf file. You can select choose which fields are joined to select which columns will be included in the merge.

Data Point Appearance

Double-click on the layer name OR right-click > Layer properties > Style. From this screen, you can easily change the color and size of all data points.

Print Composer

Use print composer to add the finishing touches to a map or project and prepare it for export.Upload map

Project > New print composer > Assign the map a composer title to save as Upload a map project and drag the map to the desired size over the workspace. Change the size of the workspace in the composition window and select from the drop-down menu of presets under page size. In some scenarios, it may be useful to upload more than one map project at a time. Repeat the same steps to overlay maps.

Think of this image as a window into the main QGIS window where the map project lies. To change the layout or position of the map project on the workspace, go to item properties and select set to map canvas extent. This will change the position of the map to that seen in the main QGIS window. Adjust the view in the main QGIS window and repeat these steps until the map appears as desired. Finally, to create a border around a map, go to item properties and select frame. From here, you can adjust the color and thickness of the border.

Add Scale/Legend

Add a scale bar to the print composer map. Edit the scalebar under item properties. If more than one map is present, select which map the scalebar should be fitted to. Under style, you can change the appearance, units, and multiplier of the scalebar. The number of segments on each side of the 0 on the scalebar can also be edited. Add a legend to the print composer map. Edit the legend by selecting legend items within item properties. By default, the legend will include the name of all layers present in the main QGIS window. If you want fewer labels, deselect auto update, highlight the layers to be deleted, and click the delete button.

Using PowerPoint

Once you have added the basic components of the map, such as a scale and a legend, you can export the map as a jpeg.Composer > Export as Image

We can then upload this image to Microsoft PowerPoint so it can be more easily edited. For example, titles and other images can be easily overlaid and edited within PowerPoint.

These modifications can also be done within the print composer window. All editing for these features can be done in the item properties.

Plug-ins

Basic Working Knowledge

Plug-ins are extra applications that can be downloaded to complete a specific task that is not easily accomplished otherwise. Unfortunately, in the newer versions of QGIS, it takes time for popular plug-ins to be updated. However, new plug-ins are always being created and added. Experimental plug-ins are in the early stages of development. They may have some kinks or may not be as user- Friendly. Deprecated plug-ins are unmaintained or obsolete and should be avoided. Where to Find Them,

Plug-ins > Manage and install plug-ins .To view experimental or deprecated plug- ins: Plug-ins > Manage and install plug-ins > Settings > Show also experimental plug-ins > Show also deprecated plug-ins

Identifying accident zones

Here analysis are done taluk wise. Importing accident data layer into georeferenced shape file of taluk wise base map point out the range of accident clusters using different colour

Major accident zones are:

- Kaipattoor-Konni road
- Omalloor-Tazhoorkadavu Road
- Tazhoorkadavu-Njakkunilam Road
- Chandanapally-Konni Road
- Pathanamthitta Tazhoorkadav Road
- Kumbazha-Malayalapuzha Road
- Pathanamthitta-Kadamanitta Road
- Ring Road

- TB Road
- Omalloor-Pariyaran Road
- Omalloor-Elavumthitta Road
- Kulanada-Omalloor Road
- Pathnamthitta-Melevettipuram Road
- Pandalam-Kaipattoor Road

Identifying causes of accidents

The major reasons for the occurrence of accidents can be point out by referencing primary collected accident datas from NATPAC

Recommendation of suitable method

After further investigation regarding places of occurrence of accidents reasons for accidents, weather conditions, road surface etc suitable methods can be recommended for reducing accident rates for future

RESULTS AND DISCUSSION

An efficient transportation system is the backbone of a country's economy. Therefore the regulation of traffic is essential for the smooth and safe movement of vehicles. Due to rapid urbanization, traffic is increasing day by day, which leads to traffic congestion at the intersection. Poor performance of the signalized intersection ultimately leads to environment pollution.Pathanamthitta district is located at southern part of Kerala, with a latitude 9.280680 and 76.869670 E longitude and has an area of 2642 km2. Many pilgrim centers including the famous Hindu pilgrimage Sabarimala is situated in Pathanamthitta district and is known as the 'Pilgrim capital of Kerala'.

MAJOR ACCIDENT ZONES

1. **Stadium junction Pathanamthitta:** With a latitude 9.260N and longitude 76.780 E. The junction is an intersection of four roads; Pathanamthitta– Pandalam road , ring road, Thiruvalla-Kozhencherry road, post office road. Here a traffic light signal system is existing, but it causes frequent stopping and starting of vehicles. To avoid the frequent stopping and starting of vehicles a continuous flow system should be introduced. The roundabout designed at this junction.

Present location sketch

2. **Omalloor, Pathananthitta:** Omalloor– Kaipattoor road is a major road in Pathanamthitta district which is also a part of NH183A which spans all the way from Kollam to Vandiperiyar via Pathanamthitta and Adoor. Almost 17 sub

roads that came from other towns and cities connect the main road at Omalloor itself. Traffic congestion occurs during peak

hours in Omalloor – Kaipattoor route. During the flood that occurred in the year 2018-2019, almost all the major roads were flooded with water. The water logging has caused the roads to lose its strength and durability. The lands in Pathanamthitta have hilly areas and plain marshy land. Land available for future road widening or construction is very less in Omalloor area due to the marshy land of the area. So we have proposed an elevated highway at Omalloor Kaipattoor road for smooth traffic flow.

3. **Pannivizha, Adoor:** Road stretch over a length of 11 km which connect pannivizha - Parakode road through residential areas. Most of the accidents are 'hit by Pedestrial ' . As it is well connected with residential areas accident rates can be reduced by providing designated crossing areas, side walk way with minimum width of 1 m (unobstructed width)

4. **Thrilok cine:** Road network which connect pandalam and kottarakara road. Accidents are mostly due to direct hitting of vehicles due to increased traffic volume. Proper signals or speed limit providing at NSS college junction can reduce accident rates to certain extend.

5. **Pamba:** It is a hilly remote area which connects nilakkal, the base camp of sabarimala prilgrin located in Ranni taluk. A number of vechicle passes during season and a large number of server accidents are caused due to super elevation.Due to high speed and low radius at the horizontal curve, large centrifugal force develops which could lead to "overturning of the vehicle" or "skidding of the vehicle".

6. **Kadakkad:** One of the most populated area in pandalam. Most of the building don't follow setback distances from road network is the main reason for vehicle collision. By following proper building rules and providing pedestrian side walk ways can reduce accident rates to certain extend

7. **Mylpra juction:** place at main eastern highway stretches of about 500 m has higher number of curves. The road geometry is not well suited for safe road network due to skidding of vehicles at junction. This can be reduced by increasing width of road curves to a minimum length

8. **HS Junction Adoor:** HS junction which connects KP Road. Most populated area which includes number of schools, colleges, training centers etc. A y junction is provided near UIT Adoor which connects three equally important roads. Here all converging vechicles has to move around the junctions for traffic free motion of vehicle. But due to defects in signals vechicles are not following the traffic pattern and leads to collisions. Providing a suitable lane control sign can reduce collision rate.

9. **Nellimootilpadi:** It is a slightly populated area. Most of the accidents are caused absence of lane marking, poor visibility of lane markings, faulty working of signals etc.

10. **Enath:** Accidents caused mainly due right - angle collision at SH. The collision can be reduced by providing acute crossings or Y - junction

11. **Elakalloor:** Which connects punalur - Muvattupuzha SH ;which connects a number of major roads. The rate of population at Elakalloor is high and also the usage of vehicle is also high. Therefore a single land traffic system is not suited; hence road has to be widen.

12. **Kulanada:** Which lies between MC road ; road no: SH1 of length l m which passes through rural areas has large number of accidents due to improper planning of T - junction at kulanada junction. By providing a Y junction (not to collide vehicles at right angle) can reduce accidents

13. **Kalanjoor:** There are almost 22 accidents during 3 years and 17 of them were grievance case. It's a square junction accidents are caused due to obstructions and poor visibility of markings. By rectifying these fault can reduce accidents.

14. **Koodal:** It is a large town in konni taluk. It is connected with Eastern highway. It is slightly an elevated area hence high rate of slippery of vehicle due to narrow roads. These can be over changed by good geometric design by providing sufficient road width, good road surfaces for non slippery.

15. **14 th mile:** MC road stretches 300 m is considered as black spot. The road stretches of 300 m is a straight road network causes higher rate of accidents by parking of vechicles at bell mouth of junctions, unorganized on - street parkings, Absence of pedestrian facilities etc.

16 **Thiruvalla Bypass:** 2.3 Km long road which connect Thiruvalla Mallappally road with MC road at Ramanchira. There are 6 signals within 2.3 km which is one of the man difficulties for travellers major accident occurs at Thiruvalla-Mallappally cross Jn by providing speed-limit equipments accidents can be reduced.

Taluk name	No. Of death	No. Of grievance	No. Of minor
Thiruvalla	48	509	330
Mallappally	15	109	98
Ranny	22	238	44
Kozhenchery	500	410	327
Adoor	52	663	136
Konni	15	190	72

Table: Accident data of Pathanamthitta district(Taluk wise-2019-2021)

	A	B	C	D	E	F
1	Taluk code	Taluk Name	Population	No. of death	No. opf grievence	No. of minors
2	I	Thiruvalla	153782	48	509	330
3	II	Mallappally	133907	15	109	98
4	III	Ranny	160705	22	238	44
5	IV	Kozhenchery	208364	500	410	327
6	V	Adoor	200253	52	663	136
7	VI	Konni	189496	15	190	72

(Table) Max Super elevation	Zone
e ≤ 0.7	Plan and rolling
e ≤ -0.7	Snowfall
e ≤ 0.1	Mountainous
e ≤ 0.04	Urban

CONCLUSION

Pathanamthitta district is slightly a hilly area and known as the headquarters of pilgrim. Hence a large number of vehicles pass through Pathanamthitta district.By analysis of past 3 year accident data (2019- 2021) around 4000 accidents were recorded due to improper road safety network. In this project, QGIS

software is used for collecting geospatial information of Pathanamthitta district and concluded that the major accident zones in Pathanamthitta district are stadium junction , Omalloor, Pannivizha, Thiruvalla bypass, Koodal, HS Junction Adoor and so on. By the analysis through accident reports , suggestions were made to reduce the accident rate . Some of the suggestions are:

- Provide a roundabout design at Stadium junction, Pathanamthitta
- Propose an elevated highway on Omalloor
- Provide designated crossing area, sidewalk way at Pannivizha
- Provide Y junction at Kulanada
- Provide speed limit equipments at Thiruvalla bypass
- Provide suitable lane control signs at HS junction , Adoor and so on Implementation of safety planning methods in effective way can reduce the accident rate.